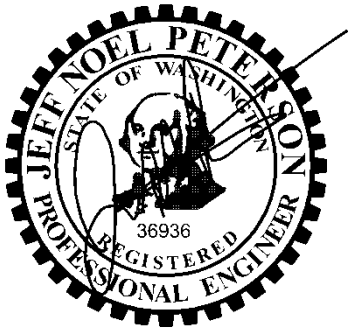
COUGHLINPORTERLUNDEEN
STRUCTURAL CIVIL SEISMIC ENGINEERING

Stormwater Management Report
Draft – 100% PREP

Emerald Heights – AL Building

10901 176th Circle NE, Redmond, WA 98052
March 09, 2017



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PROJECT OVERVIEW

General Description

Emerald Heights is currently in the process of designing multiple phases of additions and renovations to its Redmond Campus. Emerald Heights first opened its doors in Redmond in 1992. A major additions and renovations project occurred in 2002 creating additional living units and expanding service facilities. Currently, Emerald Heights is in the process of a Multi-phase additions and renovations project, the first of which was completed in 2012. The first phase of construction included the construction of a new fitness center, clinic connection, and multiple parking areas around the site. Phase 1 construction also included the expansion of an existing detention pond, first constructed as a part of the 2002 expansion, to mitigate the addition of impervious surfaces. The second phase of construction included the addition of a multi-purpose facility and new parking areas and the trailside building, a multi-story residential building with below grade parking. The following is a summary of phases of work that is referenced in this report;

- 2002 Improvements
- Fitness Center (includes parking in various locations around the site)
- Multi-purpose Building (Includes parking south of the main building)
- Trailside Building (Residential building with below grade parking)
- New Assisted Living Building (current phase of development)

The current phase of construction, for which this drainage report is written, includes the addition of a residential building known as the New Assisted Living Building.

Existing Conditions

The Emerald Heights Redmond Campus site is located adjacent to mostly residential properties and is directly north of Redmond High School. The site address is 10901 176th Circle NE, Redmond, WA 98052. The parcel numbers are 8901069008 and 8708040810. The existing site is 37.8 acres and consists of four separate drainage basins, or threshold discharge areas (See Figure 6 – Campus Basin and Downstream Conveyance Map).

The New Assisted Living Building project site is located at the east end of the parcel adjacent to 179th Avenue NE. Currently this area consists of a mix of covered and uncovered parking as well as landscaping and native vegetation. A nature trail exists east of the parking lot, which will be included in the final design of the New Assisted Living Building.

Proposed Conditions

The proposed building consists of 1-level of below grade parking and 3-stories of above grade structure composed of residential units. Site development associated with the project will include grading, paving, site access, on-site stormwater management, and utility coordination (including a fire plan). The purpose of this preliminary stormwater report is to provide an understanding of existing and proposed site conditions, as well as to outline the proposed drainage system.

Figure *3.2 Flow Chart for determining Requirements for New Development* of the City of Redmond 2012 Stormwater Technical Notebook indicates that this project is required to comply with the modified minimum requirements #1-9 of the Stormwater Technical Notebook. As such, flow control and water quality treatment were evaluated for this project.

DRAINAGE ANALYSIS

Upstream Analysis

The proposed site will match the existing grade at the project limits as to not alter flow paths or drainage basins. However, the proposed location of the detention vault and building replace an existing stormwater dispersion trench; the site will receive some fairly non-significant flows from the previously dispersed area but they will be accounted for in the stormwater detention vault design.

Downstream Analysis

The proposed site will discharge to the private storm outfall to the public storm system within the 179th Avenue NE Right-of-Way. The public storm system flows via a piped drainage system through residential neighborhoods to its outfall into Bear Creek. Beer Creek drains to the south, eventually joining the Sammamish River near the 520 Bridge crossing south of downtown Redmond. Please see *Figure 5 – Downstream Conveyance System*.

PROPOSED DRAINAGE SYSTEM

Flow Control

The proposed development requires flow control based on criteria set forth in the 2012 City of Redmond Stormwater Technical Notebook; Flow control facilities are required for "projects in which the total effective impervious surfaces is 10,000 square feet or more in a threshold discharge area." This section outlines the system used to achieve compliance with the 2014 SMMWW minimum requirements as adapted by the City of Redmond.

Flow control on-site will be achieved through a concrete detention vault located at the south side of the building. The proposed vault provides 15,000 cubic feet of live storage for runoff collected from the roof and surrounding landscape/hardscape. The graphic for the contributing area to the detention vault can be found in *Figure 3 – Proposed Conditions*. See Table 2 below for a breakdown of the land cover areas.

TABLE 1: EXISTING LAND COVER

Land Cover	Existing (Square Feet)	Existing (Acres)
Non-Pollution Generating Impervious Surface (NPGIS)	7,200 SF	0.16 ac
Pollution Generating Impervious Surface (PGIS)	2,950 SF	0.07 ac
Pervious Surfaces	28,080 SF	0.65 ac
Upstream Impervious Surface	1,980 SF	0.05 ac
Total Area	**40,400 SF**	**0.93 ac**

TABLE 2: PROPOSED DEVELOPMENT LAND COVER

Land Cover	Proposed (Square Feet)	Proposed (Acres)
Non-Pollution Generating Impervious Surface (NPGIS)	22,920 SF	0.53 ac
Pollution Generating Impervious Surface (PGIS)	4,210 SF	0.10 ac
Pervious Surfaces	11,290 SF	0.26 ac
Upstream Impervious Surface	1,980 SF	0.05 ac
Total Area	**40,400 SF**	**0.93 ac**
Vegetated Roof [1]	1,540 SF	0.04 ac

[1]Vegetated roof area is included in the total "Non-Pollution Generating Impervious Surface (NPGIS)" area.

The proposed system shall match flow durations from forested conditions between 50% of the 2-year storm event through the full 50-year storm event, according to 2014 SMMWW as adapted by the City of Redmond.

The peak flows of pre-existing (forested) and proposed conditions, calculated in MGS Flood, are:

TABLE 3: EXISTING AND PROPOSED CONDITION PEAK FLOWS

Pre-existing Runoff		Post-development Runoff		Net Reduction
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)	Discharge (cfs)
2-Year	0.020	2-Year	0.017	0.003
10-Year	0.042	10-Year	0.036	0.006
100-Year	0.078	100-Year	0.049	0.029

The complete MGS Flood report can be found in Appendix B: Engineering Calculations.

Water Quality Treatment

The proposed development does not requires water quality based on criteria set forth in the 2012 City of Redmond Stormwater Technical Notebook; Water quality facilities are required for “projects in which the total of pollution generating impervious surface (PGIS) is 5,000 square feet or more in a threshold discharge area of the project.”

Though water quality is not required per City of Redmond requirements, a wet vault is proposed in order to reduce the potential sediment carried in the stormwater runoff from accumulating in downstream structures. The wet vault supplies an average of 2.04 feet of water quality depth to supply a total of 5,140 cubic feet of water quality volume. MGS Flood was utilized to calculate the required water quality volume to treat 91 percent of the entire runoff volume over a multi-decade period of record. The water quality design storm volume was calculated to equal 2,750 cubic feet, and therefore the proposed wet vault provides sufficient volume.

IV. DISCUSSION OF MINIMUM REQUIREMENTS

MR #1: Preparation of Stormwater Site Plans

Stormwater plans and reports that address each of the applicable minimum requirements will be prepared by a licensed civil engineer in accordance with City Requirments.

MR #2: Construction Stormwater Pollution Prevention Plan (SWPPP)

A SWPPP will be provided at a later date and a CESCL will be appointed by the contractor.

a. Element 1: Preserve Vegetation/Mark Clearing Limits
   i. Clearing Limits are noted on plans and will be implemented prior to any offsite impacts or damage due to construction. Existing vegetation will be protected and retained to the maximum extent feasible.

b. Element 2: Establish Construction Access
   i. The Contractor, per the plans, shall implement necessary BMP measures to ensure sediment does not leave site onto streets or adjacent properties.

c. Element 3: Control Flow Rates
   i. Project construction shall implement sediment ponds and/or baker tanks in accordance with City standards.

d. Element 4: Install Sediment Controls
   i. Project construction shall implement sediment ponds and/or baker tanks in accordance with City standards. The SWPPP will be provided at a later date and a CESCL will be appointed by the contractor.

e. Element 5: Stabilize Soils
   i. Soils shall be stabilized through a series of BMPs for any period of more than 7 days in dry weather or 2 days in wet weather.

f. Element 6: Protect Slopes
   i. All slopes will incorporate the applicable BMPs per the plans.

g. Element 7: Protect Drain Inlets
   i. Existing drains shall be protected where applicable through the project site.

h. Element 8: Stabilize Channels and Outlets
   i. Channels and outlets shall be protected and stabilized where applicable through the project site.

i. Element 9: Control Pollutants
   i. BMPs shall be implemented to prevent or treat contamination of stormwater runoff by pH modifying sources. In addition, all waste materials from the site will be removed in a manner that does not cause contamination of stormwater.

j. Element 10: Control De-Watering
   i. De-watering is not expected to be implemented for the project due to low groundwater.

k. Element 11: Maintain BMPs
   i. BMPs listed in the SWPPP shall be maintained as needed through the project. As portions of the project get completed, portions of the established BMPs shall be adjusted to other areas of the project site until their completion.

l. Element 12: Manage The Project
   i. Proposed erosion and sediment control measures will be implanted throughout construction as needed.

MR #3: Source Control of Pollution

Stormwater will be prevented from coming in contact with pollutants through a series of BMPs listed within the SWPPP. The SWPPP will be provided at a later date and a CESCL will be appointed by the contractor.

MR #4: Preservation of Natural Drainage Systems and Outfalls

Downstream receiving waters will not be adversely affected by the construction or completion of this project. No new drainage patterns offsite are expected with this project. The project is conveying water to the same private storm system as the existing condition.

MR #5: On-Site Stormwater Management

Projects shall employ On-site Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent feasible without causing flooding or erosion impacts during construction. Finished conditions for the site will meet the requirements set forth in #6-9. See Section "VI Low Impact Development" for implementation of stormwater BMPs.

MR #6: Runoff Treatment

On-site constructed water quality measures are not required for this project. The project proposes less than 5,000 square feet of PGIS within the project line therefore no water quality facilities are required. However, in order to reduce future maintenance for structures downstream from the detention vault, 5,140 cubit feet of water quality storage is being proposed as a wet vault. Additional requirements apply to the project since it is in Well Protection Zone III, however no surface discharge of PGIS is proposed and no infiltration is proposed and therefore no additional water quality is required.

MR #7: Flow Control

On-site constructed flow control measures are required for this project. The project is proposing more than 10,000 square feet of effective impervious service therefore a concrete detention vault is proposed to meet flow control requirements.

MR #8: Wetlands Protection

Stormwater from this site does not discharge into a wetland and therefore wetlands protection is not required as per section 2.5.8 of the City of Redmond Clearing, Grading, and Stormwater Management Technical Notebook.

MR #9: Operation and Maintenance

An operation and maintenance manual that is consistent with the provision in Volume V of the City's Stormwater Technical Notebook shall be provided for all proposed stormwater facilities and BMPs. The Operation and Maintenance Manual will be provided in Appendix E in later editions of this report.

v. TEMPORARY EROSION AND SEDIMENT CONTROL

Erosion control systems will be implemented throughout the construction process until the site is stabilized. All temporary erosion and sedimentation control requirements will be in compliance with Chapter 15.24 of the Redmond Municipal Code and the Department of Ecology (DOE) Best Management Practices (BMPs). Best Management Practices are defined as physical, structural and/or managerial practices, that when used singly or in combination, prevent or reduce pollution of storm water runoff caused by construction activities. The Dry Season Temporary Erosion and Sedimentation Control plan for the proposed site has been designed to protect off-site properties as well as to prevent sediment-laden water from entering the public storm system. A “wet weather plan” will be developed prior to construction in the rainy season.

VI. LOW IMPACT DEVELOPMENT

Low impact development (LID) on the project site was assessed to meet the minimum requirements set forth in Sections 8.7.4 and 8.7.5 of the 2012 Stormwater Technical Notebook. This project is required to evaluate the feasibility of BMPs in List #2 of the 2014 SWMMWW but is not required to meet the LID Performance Standard (See *Figure 8c Flow Chart for Determining LID MR #5 Requirements*).

The following LID BMP's were considered in an effort to implement On-Site Stormwater Management and to meet LID Performance Standards:

Post-Construction Soil Quality and Depth: Post-Construction soil quality and depth will be implemented for the entire 11,290 square feet of the proposed landscaped area.

Full Dispersion: The available native vegetation flow path length at a less than 3:1 slope is less than 100 feet, therefore full dispersion has been deemed infeasible for the project.

Downspout Full Infiltration: Downspout full infiltration has been deemed infeasible for the project because the site does not meet minimum setback requirements, the site does not consist of outwash or loam soils, and the native soils do not meet minimum required infiltration rates.

Bioretention Cells, Swales, and Planter Boxes: Bioretention has been deemed infeasible for on-site stormwater management because infiltration was deemed infeasible for the project: bioretention may be used with underdrains when the native soil infiltration rates are less than 0.30 inches/hour, however in order to receive credit for on-site stormwater management underdrains must not be used.

Downspout Dispersion Systems: Downspout dispersion systems have been deemed infeasible because it does not meet minimum required vegetated flow path and minimum required setbacks from the property line and structures.

Perforated Stub-Out Connections: The roof is internally drained and no downspouts are proposed for the project. Additionally, roof area routed through a downspout dispersion system could not be routed to the detention vault via gravity flow.

Permeable Pavements: Permeable has been deemed infeasible for on-site stormwater management because the native soil infiltration rate is less than 0.30 inches/hour; permeable pavements may be used with underdrains when the native soil infiltration rates are less than 0.30 inches/hour, however in order to receive credit for on-site stormwater management underdrains must not be used.

Sheet Flow Dispersion: Sheet flow dispersion has been deemed infeasible because the impervious surfaces onsite either 1) do not have a vegetated surface directly adjacent or 2) are concentrated flows.

Concentrated Flow Dispersion: Due to site constraints concentrated flows would not maintain the minimum vegetated flow of at least 50 feet between the discharge point and the property line or the adjacent existing detention pond.

Tree Retention and Tree Planting: The project proposes to retain 7 trees on site and to plant 93 trees. Of the 100 total trees 3 existing evergreens, 7 new deciduous, and 7 new evergreen trees will be used for onsite stormwater management. The trees used for onsite stormwater management fulfill the requirements of size and proximity to ground level impervious surface. The new and retained trees mitigate a total of 790 square feet (0.02 acres) of impervious area.

Vegetated Roofs: The project proposed 1,540 square feet of vegetated roof with more than 8 inches of soil. Vegetated roof used for onsite stormwater management can be modelled as 50% impervious and 50% pervious area, as stated in the 2014 SWMMWW.

Due to site constraints and infeasibility criteria provided above the project is proposing to provide Onsite Stormwater Management and LID to the maximum extent feasible.

The following are the responses to the site assessment minimum requirements as noted in Section 8.7.5:

1. *A survey prepared by a registered land surveyor showing existing public and private development, including utility infrastructure, on and adjacent to the site, major and minor hydrologic features, including seeps, springs, closed depression areas, drainage swales, and 2 foot contours up to 10 percent slope and 5 foot contours for slopes above 10 percent. Spot elevations shall be at 25 foot intervals.*

   A survey has been prepared by a registered land surveyor meeting the required criteria.

2. *Location of all existing lot lines, lease areas and easements.*

   A survey has been prepared by a registered land surveyor meeting the required criteria.

3. *A soils report prepared by a licensed geotechnical engineer or licensed engineering geologist. The report shall identify:*

   a. Underlying soils on the site utilizing soil pits and soil grain analysis to assess infiltration capability on site. The frequency and distribution of test pits shall be adequate to direct placement of the roads and structures away from soils that can most effectively infiltrate stormwater;

   b. Percolation tests if appropriate or requested by the Stormwater Engineer;

   c. Topographic and geologic features that may act as natural stormwater storage or conveyance and underlying soils that provide opportunities for storage and partial infiltration;

   d. Depth to wet season high groundwater;

   e. Geologic hazard areas and associated buffer requirements as defined in RZC 21.64.060;

   f. Distance from site boundaries to any areas within 200 feet of the site identified as landslide hazard areas or having a slope of 40 percent or steeper with a vertical relief of 10 feet or more; [Note: the City may require the applicant to expand the 200 feet to encompass a larger area if there are concerns for downstream geological hazards.]

   g. Identification of Wellhead Protection Zone(s); and

   h. For previously cleared or graded sites, analysis of topsoil according to the soil

   i. requirements in the City of Redmond Standard Specifications, Section 9.14.1.

   A geotechnical report has been prepared by a licensed geotechnical engineer meeting the required criteria (see Appendix D, *Geotechnical Report*), which includes a letter describing the infiltration testing done on-site. As an added clarification to the submitted documents the project Geotechnical Engineer, Jeffrey Laub, has confirmed that it is his professional opinion that infiltration is infeasible onsite due to the presence of very dense glacially consolidated lodgment till soils. In addition to the limited infiltration on-site there is not any location to install an infiltration facility due to City of Redmond setback requirements; see attached *Figure 7 – LID Site Plan* for addition information. Also a topographic survey has been prepared by a licensed surveyor to meet the required criteria.

4. *A survey of existing native vegetation cover and wildlife habitat by a qualified biologist identifying any forest areas on the site, species and condition of ground cover and shrub layer, and tree species, seral stage, and canopy cover.*

   A survey has been prepared by a registered land surveyor meeting the required criteria.

5. *A streams, wetland, and water body survey and classification report by a qualified biologist showing wetland and buffer boundaries consistent with the requirements of RZC 21.64.030 and Critical Areas Reporting Requirements (RZC Appendix 1).*

   A survey has been prepared by a registered land surveyor meeting the required criteria.

6. *Flood hazard areas on or adjacent to the site.*

   A survey has been prepared by a registered land surveyor. There are no flood hazards on or adjacent to the site.

7. *A preliminary drainage report providing analysis of the existing site hydrologic conditions on the site and recommendations for type, location, and restrictions on LID BMPs.*

   See Appendix B, Drainage Calculations, for a hydrologic analysis of the project site.

8. *Other studies as deemed necessary by the Stormwater Engineer.*

   No other documents have been identified as being necessary for LID assessment.

APPENDIX A: FIGURES

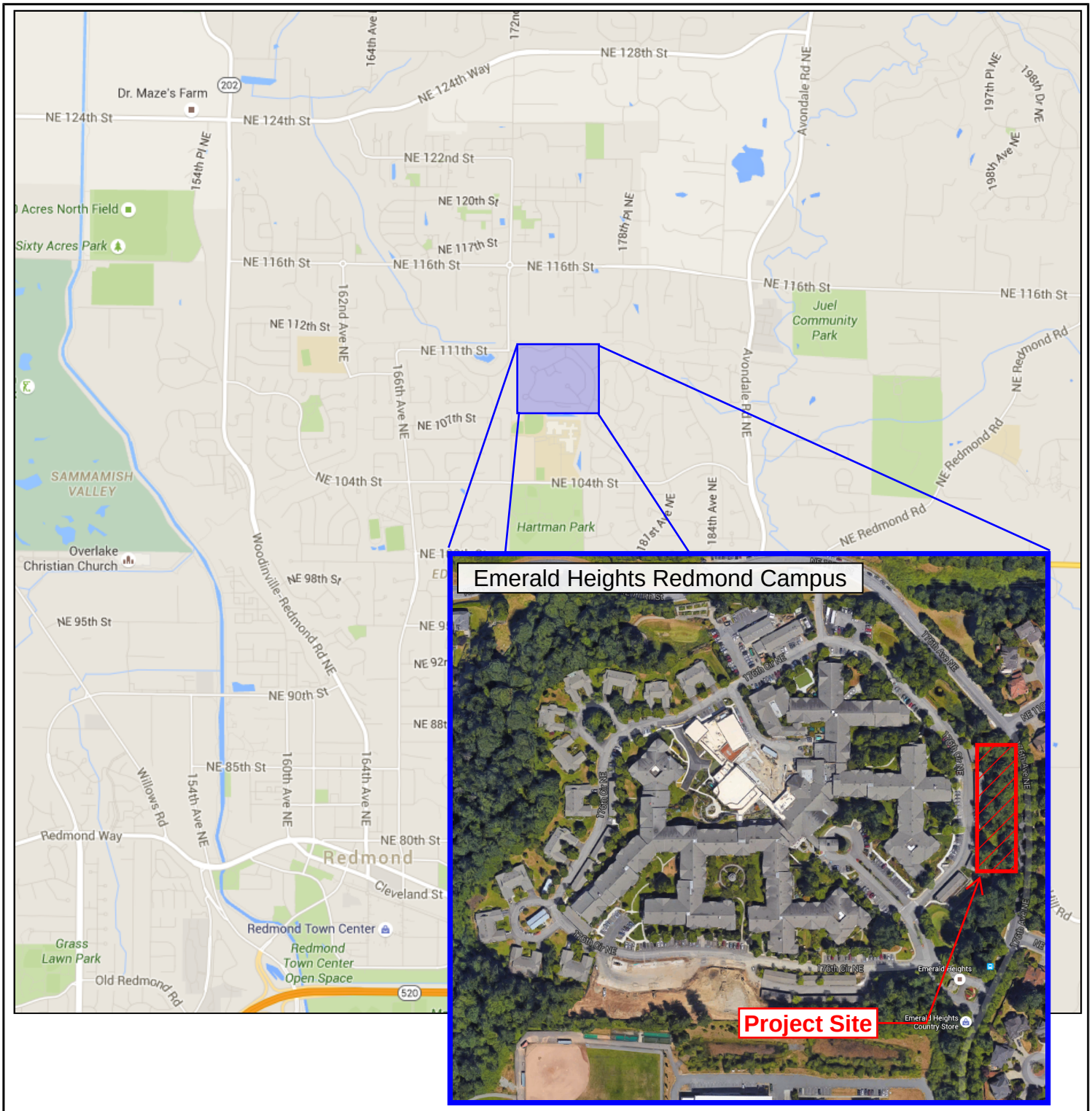

Figure 1 - Vicinity Map

NTS

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Project:	EH: Assisted Living Building	Designed By:	IDS
Project No:	C150030-02	Client: Rice Fergus Miller	Checked By: BSB
Date:	06/09/2016	Sheet:	

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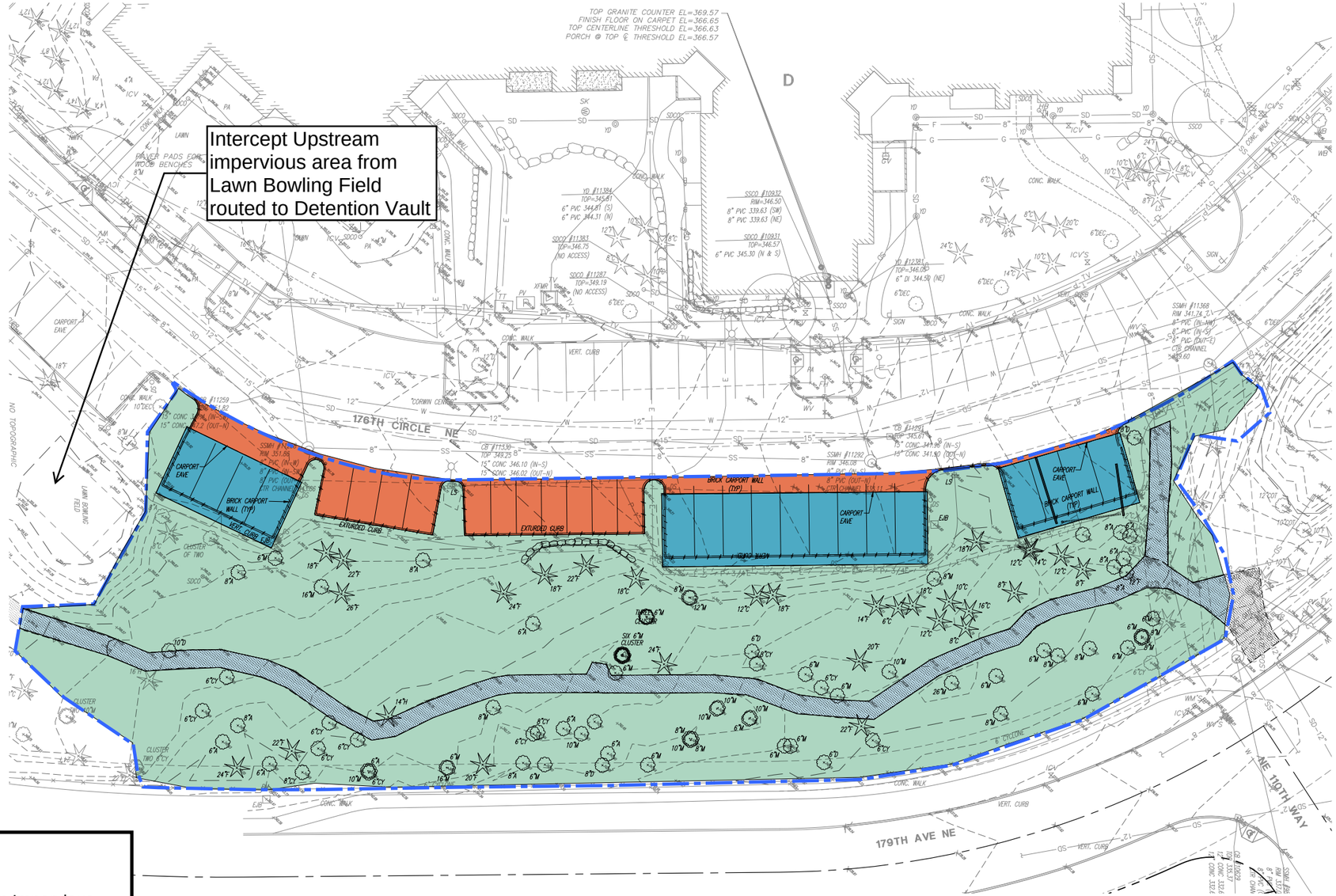
Legend

- Impervious Area: 4,210 (0.097 ac)
- PGIS Area: 2,950 SF (0.068 ac)
- Gravel Path Area: 3,020 SF (0.069 ac)
- Pervious Area: 28,240 SF (0.648 ac)
- Upstream Impervious Area: 1,980 (0.045 ac)
- Total Area: 40,400 SF (0.927 ac)
- Project Limits



MGS Flood Existing Areas

Till Forest: Impervious + PGIS + Gravel Path + Pervious+ Upstream Impervious

Till Forest: 0.097 + 0.068 + 0.069 + 0.648 + 0.045

Till Forest: 0.927 acres

Total Area: 0.927 acres

Figure 2 - Existing Conditions

Scale: 1"=40'

Project: EH: Assisted Living Building		Designed By: IDS	Date: 02/22/2017
Project No: C150030-02	Client: Rice Fergus Miller	Checked By: BSB	Sheet:

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Legend (Total)

- Impervious Roof: 16,130 SF (0.370 ac)
- Impervious Hardscape: 6,790 SF (0.156 ac)
- Pervious Landscape: 11,290 SF (0.259 ac)
- PGIS: 4,210 SF (0.097 ac)
- Upstream Impervious: 1,975 SF (0.045 ac)
- Total Area: 38,420 SF (0.927 ac)
- Project Limits

Legend (Bypass)

- Impervious Bypass: 420 SF (0.010 ac)
- Pervious Bypass: 7,290 SF (0.167 ac)
- PGIS Bypass: 960 SF (0.022 ac)

Legend (BMP)

See Figure 7 - LID Site Plan

MGS Flood Proposed Areas

Impervious Bypass: Impervious Bypass + PGIS Bypass - BMPs[1]

Impervious Bypass: 0.010 + 0.022 - 0.007

Total Impervious Bypass: 0.025 acres

Till Grass Bypass: BMPs[1]

Till Grass Bypass: 0.007 acres (3 EX Evergreen)

Till Pasture Bypass: Pervious Bypass[2]

Till Pasture Bypass: 0.167 acres

Impervious Area: Roof + Hardscape + Upstream + PGIS - Impervious Bypass - PGIS Bypass - BMPs[1,3]

Impervious Area: 0.370 + 0.156 + 0.045 + 0.097 - 0.010 - 0.022 - 0.030

Impervious Area: 0.606 acres

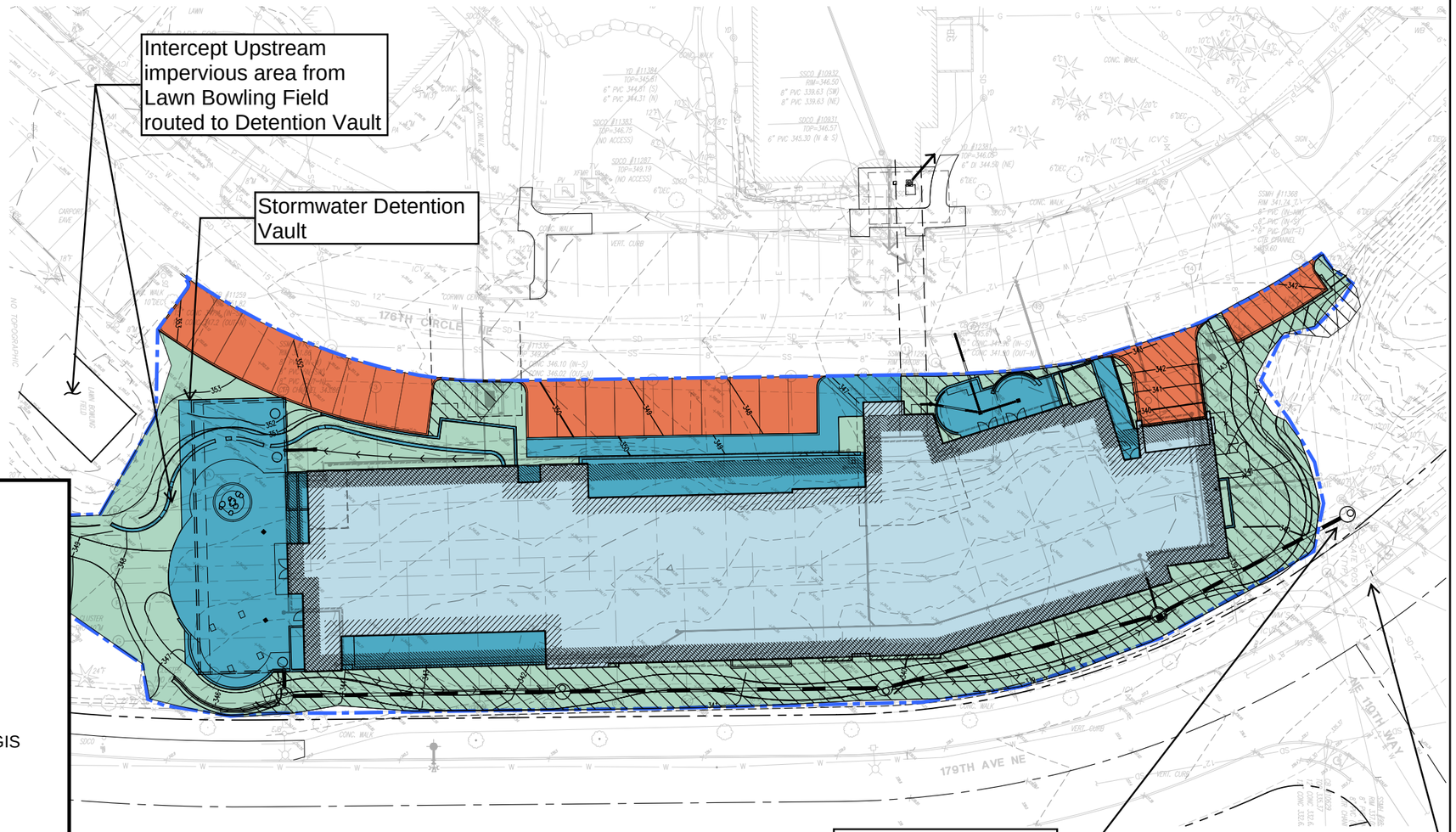
Till Grass Area: BMPs[1,3]

Till Grass Area: 0.030 acres (7 Evergreen, 7 Deciduous + 50% Veg. Roof)

Till Pasture Area: Pervious Landscape[2] - Pervious Bypass[2]

Till Pasture Area: 0.092 acres

Total Area: 0.927 acres



[1]Tree retention and tree planting mitigates impervious surface to be modeled as till grass per 2014 SWMMWW Volume V, Chapter 5, Section 3.1, BMP T5.16 Flow Control Credits.

[2]Post-Construction Soil Quality and Depth mitigates till grass surfaces to be modeled as till pasture per 2014 SWMMWW Volume V, Chapter 5, Section 3.1, BMP T5.13 Runoff Model Representation.

[3]Vegetated Roof mitigates impervious area to be modeled as 50% Impervious and 50% Pervious per 2014 SWMMWW Volume V, Chapter 5, Section 3.1, BMP T5.13 Runoff Model Representation.

Figure 3 - Proposed Conditions

Scale: 1"=40'

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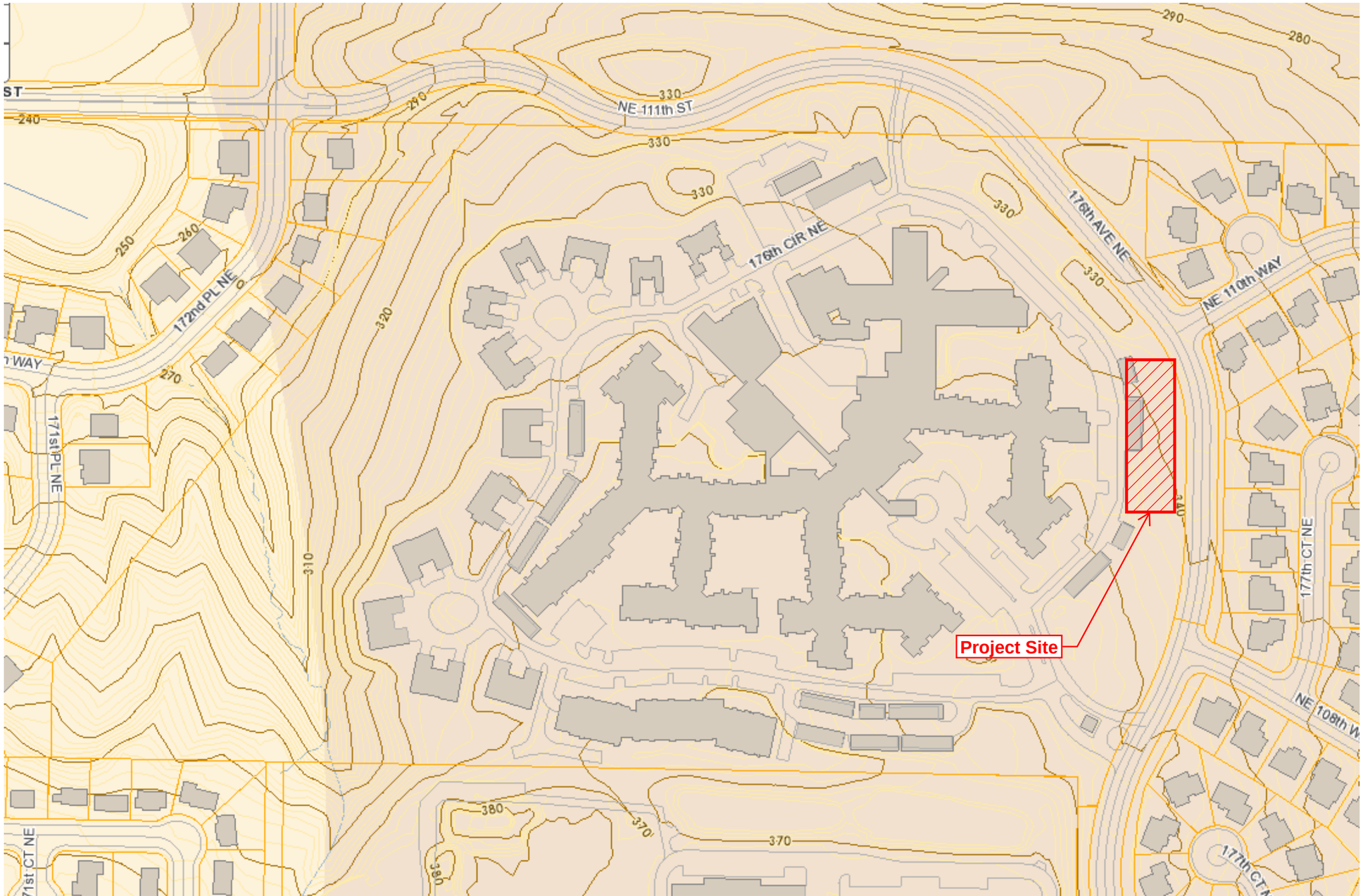
Project: EH: Assisted Living Building | Designed By: IDS | Date: 02/22/2017

Project No: C150030-02 | Client: Rice Fergus Miller | Checked By: BSB | Sheet:



- Critical Areas
  - Contours
    - INDEX
    - INDEX-DEP
    - INDEX-DEP-OB
    - INDEX-OB
    - INTER
    - INTER-DEP
    - INTER-DEP-OB
    - INTER-OB
  - Streams Classification
    - Class I Stream
    - Class II Stream
    - Class III Stream
    - Class IV Stream
  - Shoreline Environments
    - Aquatic
    - High-Intensity/Multi-Use
    - Natural
    - Shoreline Residential
    - Urban Conservancy
  - Class 1 Streams and Buffers
  - Frequently Flooded Areas
    - 100 Year Floodplain
    - FEMA Floodway
  - Wellhead Protection Zones
    - Wellhead Protection Zone 1
    - Wellhead Protection Zone 2
    - Wellhead Protection Zone 3
    - Wellhead Protection Zone 4

Figure 4 - Wellhead Protection Map
Not to Scale

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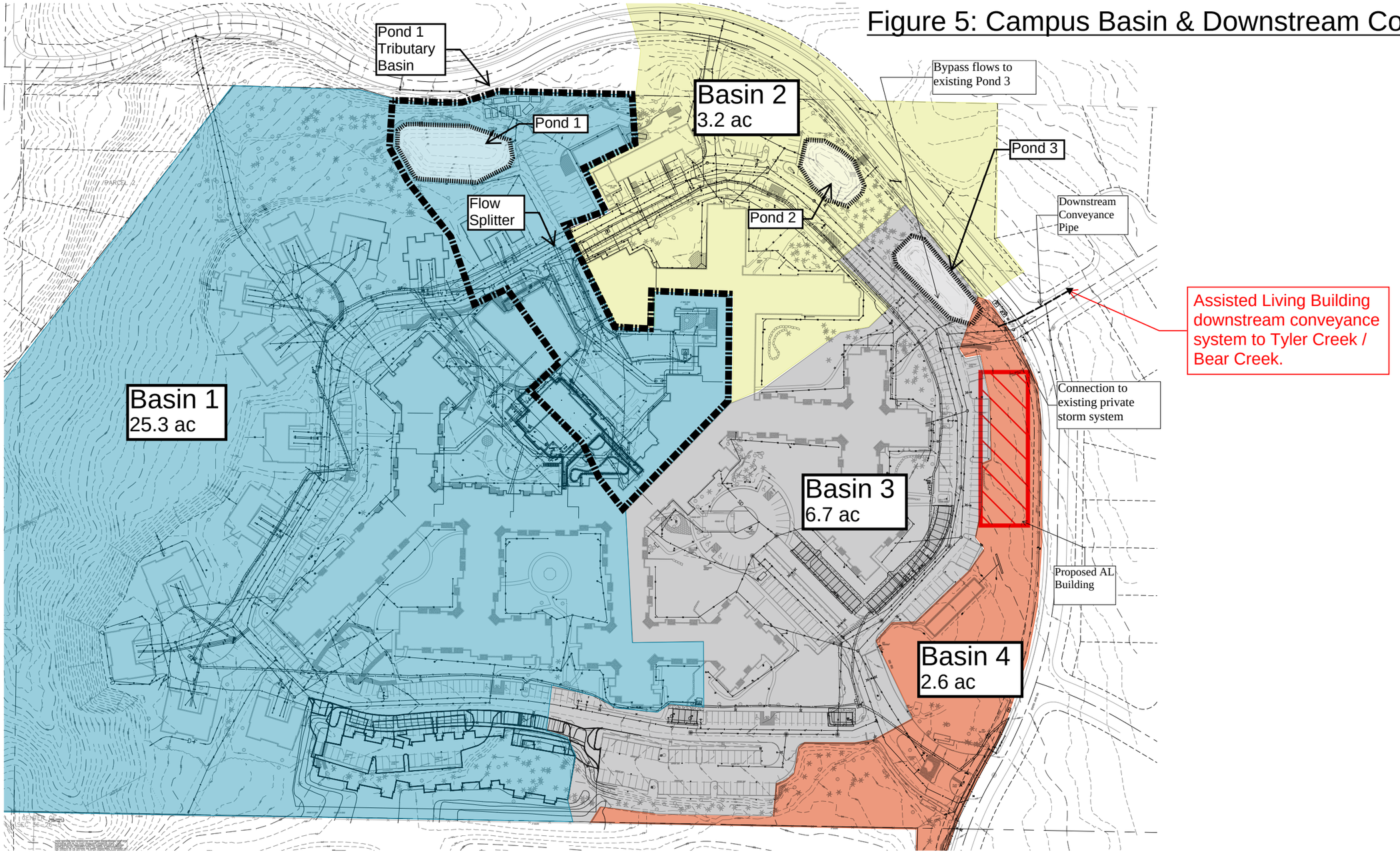
Figure 5: Campus Basin & Downstream Conveyance

Not to Scale



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Designed By: IDS
Date: 09/16/2016
Project No: C150030-02
Client: Rice Fergus Miller
Checked By: BSB
Sheet: 16

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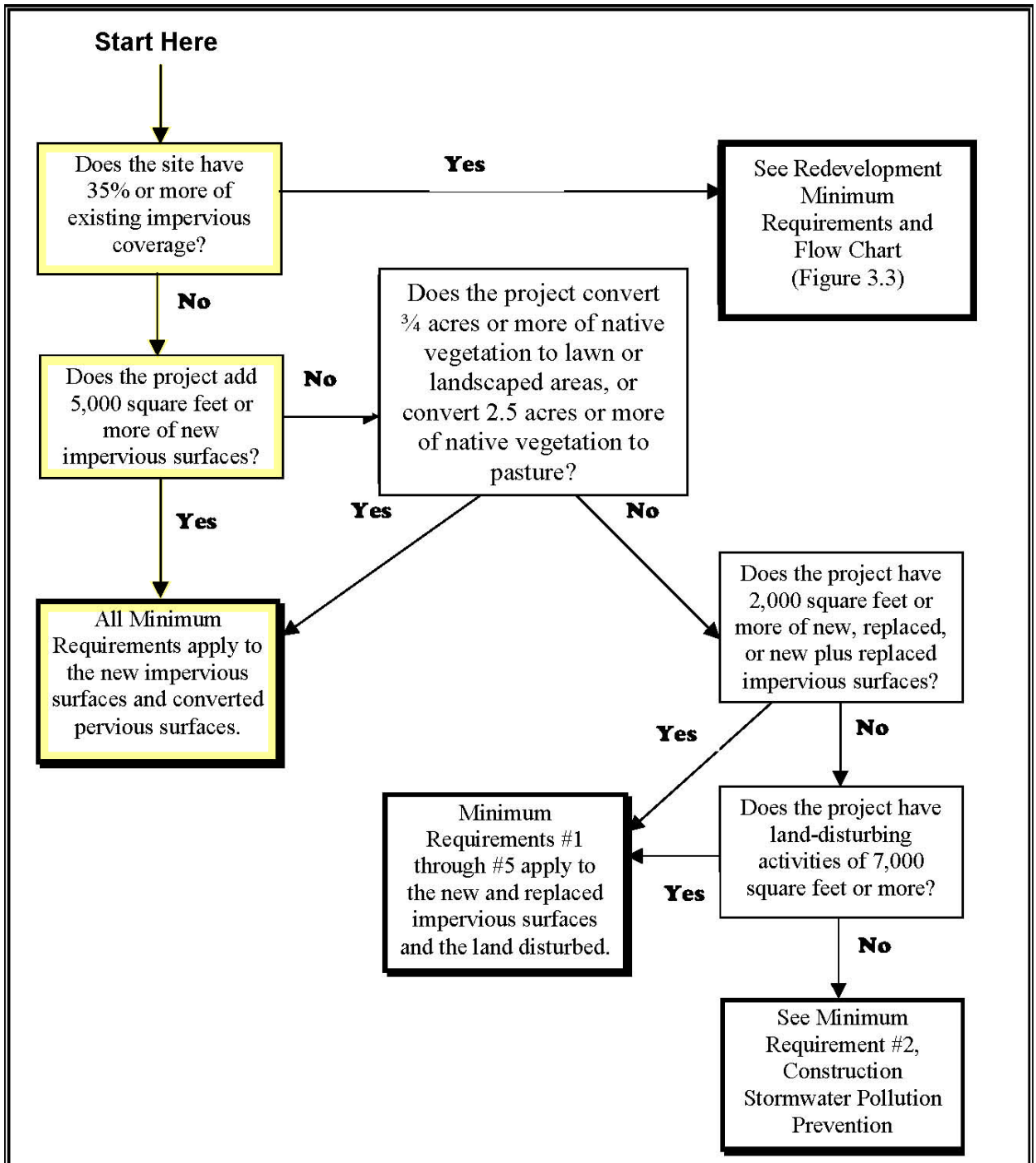


Figure 3.2 Flow Chart for Determining Requirements for New Development

Flow Chart for Determining LID MR #5 Requirements

Does the project discharge to Flow Control Exempt Waters (per Minimum Requirement (MR) #7)?

Yes

REQUIRED: Implement the following BMPs where feasible:

- BMP T5.13: Post-Construction Soil Quality and Depth
- BMP T5.10A, B, or C: Downspout Full Infiltration, Downspout Dispersion Systems, or Perforated Stub-out Connections
- BMP T5.11 or T5.12: Concentrated Flow Dispersion or Sheet Flow Dispersion

NOT REQUIRED: Achievement of the LID Performance Standard. Applying the other BMPs in List #1 or List #2.

No

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

No, the project triggered only MR #2

No additional requirements

No, the project triggered MRs #1 - #9.

Yes

Is the project inside the UGA?

Yes

No, the project is outside the UGA.

Did the project developer choose to meet the LID Performance Standard?

No, project developer chose List #1.

Yes

REQUIRED: For each surface, consider the BMPs in the order listed in **List #1** for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

Is the project on a parcel of 5 acres or larger?

No

Yes

Did the project developer choose to meet the LID Performance Standard?

Yes

No, project developer chose List #2.

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

REQUIRED for Projects Triggering MR #1-9*: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

REQUIRED: For each surface, consider the BMPs in the order listed in **List #2** for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

If the project can't meet the LID Performance Standard, it must be redesigned to meet the LID performance standard or an exception / variance must be approved.

REQUIRED: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

*Recommended by Ecology for projects triggering MR #1-5.

List #1 & List #2: For each surface, consider the BMP's in the order listed for that type of surface. Use the first BMP that is considered feasible.

BMPs	***List #1 (Project triggers Minimum Requirements #1-5)***	***List #2 (Project triggers Minimum Requirements #1-9)***
Lawn & Landscaped Areas:	• Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the *SWMMWW*	• Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the *SWMMWW*
Roofs:	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW*, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 of Volume III of the *SWMMWW.*	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW*, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 of Volume III of the *SWMMWW.*
	2. Rain Gardens in accordance with the "Rain Garden Handbook for Western Washington," or Bioretention in accordance with Chapter 7 of Volume V of the *SWMMWW.* The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.	**2.** Bioretention (See Chapter 7 of Volume V of the *SWMMWW*) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the of the total surface area draining to it
	3. Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 of Volume III of the *SWMMWW.*	**3.** Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 of Volume III of the *SWMMWW.*
	4. Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 of Volume III of the *SWMMWW.*	**4.** Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 of Volume III of the *SWMMWW*.
Other Hard Surfaces:	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW.*	**1.** Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V of the *SWMMWW.*
	2. Permeable pavement[1] in accordance with BMP T5.15 in Chapter 5 of Volume V of the *SWMMWW,* or Rain Gardens in accordance with the "Rain Garden Handbook for Western Washington," or Bioretention in accordance with Chapter 7 of Volume V of the *SWMMWW.* The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.	**2.** Permeable pavement[1] in accordance with BMP T5.15 in Chapter 5 of Volume V of the *SWMMWW*
	3. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 5 of Volume V of the *SWMMWW.*	**3.** Bioretention (See Chapter 7, Volume V of the *SWMMWW*) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the of the total surface area draining to it**.**
		4. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 5 of Volume V of the *SWMMWW.*

Refer to your Municipal Stormwater Permit, 2012 Stormwater Management Manual for Western Washington, and/or your local jurisdiction for more information about these requirements and other requirements.

[1] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

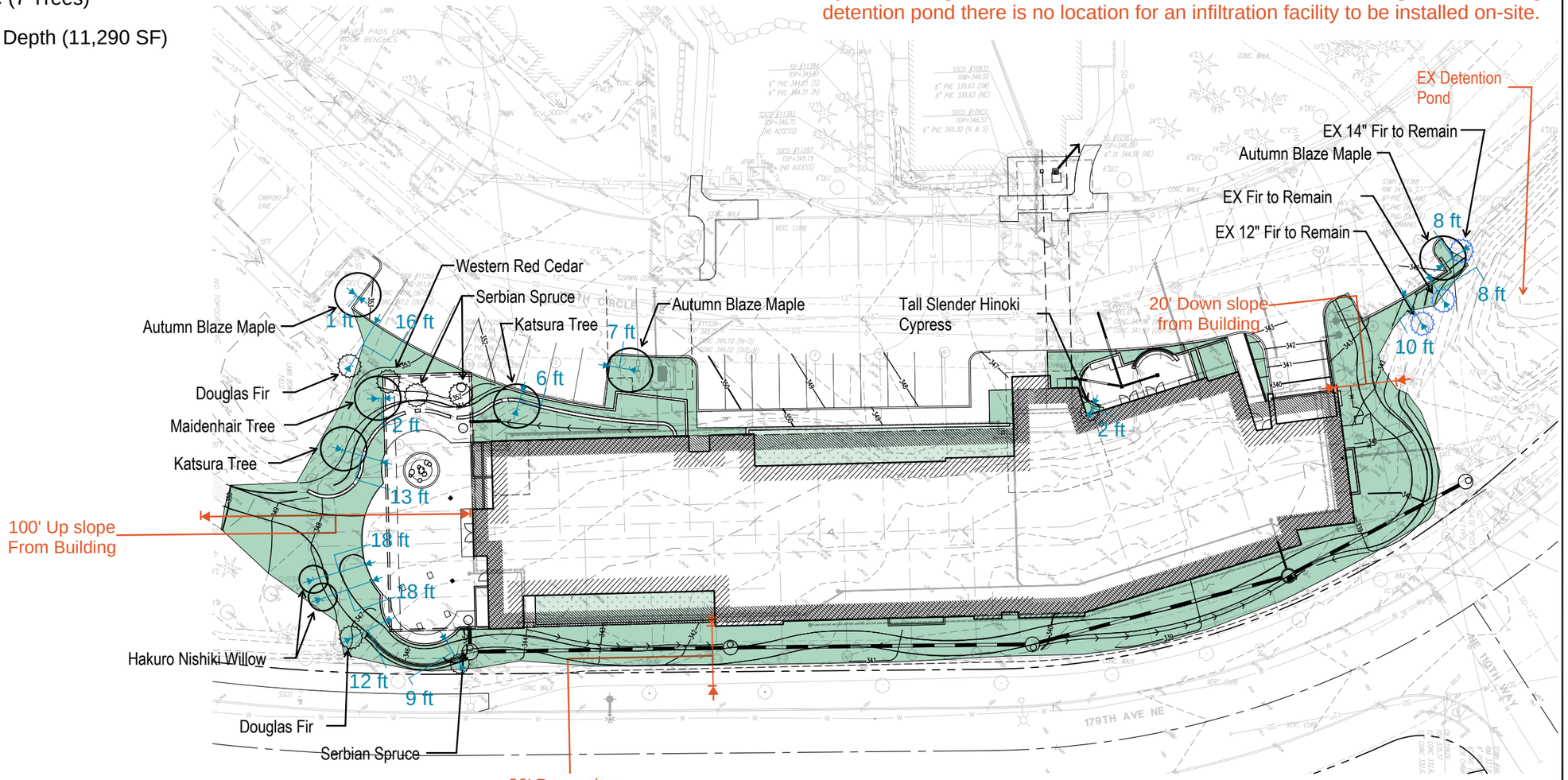
Legend

- LID Credit Planted Evergreen Tree (7 Trees)
- LID Credit Retained Evergreen Tree (3 Trees)
- LID Credit Planted Deciduous Tree (7 Trees)
- Post-Construction Soil Quality and Depth (11,290 SF)
- Vegetated Roof (1,540 SF)

Infiltration Setback Evaluation:

City of Redmond 2012 Stormwater Technical Notebook minimum setback requirements for infiltration facilities include:
1. Minimum 20' down slope and 100' up slope of building foundations.
2. 10' from NGPE and property line.

By maintaining the minimum setbacks above and not encroaching on the existing detention pond there is no location for an infiltration facility to be installed on-site.



Notes:

1. All trees used for flow control credits conform to minimum requirements described in Section V-5.3.1 BMP T5.16: Tree Retention and Tree Planting of the 2014 Stormwater Management Manual for Western Washington.
2. See landscape planting plan for additional tree descriptions and information.

Figure 7 - LID Site Plan
Scale: 1"=40'

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Project: EH: Assisted Living Building		Designed By: IDS	Date: 02/22/2017
Project No: C150030-02	Client: Rice Fergus Miller	Checked By: BSB	Sheet:

APPENDIX B: ENGINEERING CALCULATIONS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.38
Program License Number: 200610002
Project Simulation Performed on: 02/22/2017 11:03 AM
Report Generation Date: 02/22/2017 11:04 AM

Input File Name: 2017.02.08_AL Building Detention.fld
Project Name: Emerald Heights MR2
Analysis Title: Detention AL Bldg
Comments: IDS 2017.02.22

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 13

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

		Predeveloped	Post Developed
Total Subbasin Area (acres)	0.927	0.927	
Area of Links that Include Precip/Evap (acres)	0.000	0.000	
Total (acres)	0.927	0.927	

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area(Acres) --------
Till Forest	0.927
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000

Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000
Subbasin Total	0.927

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2

---------- Subbasin : Subbasin 1 ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.092
Till Grass	0.030
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.606
Subbasin Total	0.728

---------- Subbasin : Bypass ----------

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.167
Till Grass	0.007
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.025
Subbasin Total	0.199

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 2

Link Name: Detention Vault
Link Type: Structure
Downstream Link Name: Outfall

Prismatic Pond Option Used
Pond Floor Elevation (ft) : 337.75
Riser Crest Elevation (ft) : 343.50
Max Pond Elevation (ft) : 344.00
Storage Depth (ft) : 5.75
Pond Bottom Length (ft) : 87.0
Pond Bottom Width (ft) : 30.0
Pond Side Slopes (ft/ft) : L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft) : 2610.
Area at Riser Crest El (sq-ft) : 2,610.
(acres) : 0.060
Volume at Riser Crest (cu-ft) : 15,008.
(ac-ft) : 0.345
Area at Max Elevation (sq-ft) : 2610.
(acres) : 0.060
Vol at Max Elevation (cu-ft) : 16,574.
(ac-ft) : 0.380

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.000
Riser Crest Elevation : 343.50 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 337.75
Diameter (in) : 0.38
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 342.17
Diameter (in) : 0.87
Orientation : Horizontal
Elbow : No

Link Name: Outfall

Link Type: Copy
Downstream Link: None

**************************FLOOD FREQUENCY AND DURATION STATISTICS********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 2
Number of Links: 2

*************Groundwater Recharge Summary ***************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	160.730
Total:	160.730

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	19.995
Subbasin: Bypass	30.461
Link: Detention Vault	0.000
Link: Outfall	0.000
Total:	50.456

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 1.017 ac-ft/year, Post Developed: 0.319 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 2

********** Link: Detention Vault **********

Basic Wet Pond Volume (91% Exceedance): 2749. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 4123. cu-ft

2-Year Discharge Rate : 0.007 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge
On-line Design Discharge Rate (91% Exceedance): 0.09 cfs
Off-line Design Discharge Rate (91% Exceedance): 0.05 cfs

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 286.97
Inflow Volume Including PPT-Evap (ac-ft): 286.97
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 286.90
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Outfall **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 323.55
Inflow Volume Including PPT-Evap (ac-ft): 323.55
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 323.55
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

************Compliance Point Results **************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Outfall

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.968E-02	2-Year	1.670E-02
5-Year	3.359E-02	5-Year	2.572E-02
10-Year	4.180E-02	10-Year	3.626E-02
25-Year	5.393E-02	25-Year	4.234E-02
50-Year	6.493E-02	50-Year	4.622E-02
100-Year	7.794E-02	100-Year	4.916E-02
200-Year	0.105	200-Year	5.472E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-15.8%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-15.8%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-6.3%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

APPENDIX C: CONVEYANCE ANALYSIS

To be included in later versions of this Report.

APPENDIX D: GEOTECHNICAL REPORT

APPENDIX E: OPERATIONS AND MAINTANENCE MANUAL

To be included in later versions of this Report.